

# **INDOOR AIR QUALITY ASSESSMENT**

**Northwest Elementary School  
45 Stearns Avenue  
Leominster, MA 01453**



Prepared by:  
Massachusetts Department of Public Health  
Center for Environmental Health  
Emergency Response Indoor Air Quality Program  
September 2005

## **Background/Introduction**

At the request of the Leominster Health Department, the Massachusetts Department of Public Health's (MDPH) Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality at each of Leominster's public schools. These assessments were jointly coordinated through Chris Knuth, Director of the Leominster Health Department, and David Wood, Facilities Director for Leominster Public Schools (LPS). On June 2, 2005, Cory Holmes, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program, conducted an assessment at the Northwest Elementary School (NES), 45 Stearns Avenue, Leominster, Massachusetts.

The NES is a red brick building constructed in 1955. In the late 1960s, the building was renovated and an addition was built. Windows are openable throughout the building. A number of windows have been replaced. Plans to replace windows in the west side of the building are on a capital repair list. Carpeting in a number of areas has been removed and replaced with floor tile. Mr. Wood reported that carpet removal in classrooms is planned school-wide as funds become available.

## **Methods**

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector

(PID). CEH staff also performed a visual inspection of building materials for water damage and/or microbial growth.

## **Results**

The NES houses grades K through 4, with a student population of approximately 530 and a staff of approximately 65. Tests were taken under normal operating conditions. Test results appear in Table 1.

## **Discussion**

### **Ventilation**

It can be seen from Table 1 that carbon dioxide levels were elevated above 800 parts per million (ppm) in four of forty areas surveyed, indicating adequate air exchange in the majority of areas surveyed on the day of the assessment. Some areas with carbon dioxide levels below 800 ppm were sparsely populated, unoccupied and/or had windows open, which can greatly reduce carbon dioxide levels. Carbon dioxide levels would be expected to be higher with full occupancy and with windows shut.

Fresh air in exterior classrooms is supplied by unit ventilator (univent) systems equipped with high efficiency pleated filters (Pictures 1 and 2). A univent is designed to draw air from outdoors through a fresh air intake located on the exterior wall of the building (Picture 3). Return air is drawn through an air intake located at the base of the unit ([Figure 1](#)). Fresh and return air are mixed, filtered, heated and provided to classrooms through an air diffuser located in the top of the unit. All univents were operating during the assessment, with the exception of the cafeteria. Obstructions to airflow, such as papers and books stored on univents and

bookcases, carts and desks in front of univent returns, were seen in several classrooms (Picture 4). In order for univents to provide fresh air as designed, units must be activated and remain free of obstructions.

Mechanical exhaust ventilation for classrooms in the 1955 portion of the building is provided by vents located in the ceilings of coat closets (Picture 5). Air is drawn into the coat closet through the undercut below closet doors and exhausted out of the building through a centralized tower (Pictures 6 and 7). The design/location of exhaust vents allows for easy blockage by stored materials. The majority of these exhaust vents were operating, however no draw of air was detected in classrooms B1, B9 and A5, which can indicate that motors were deactivated or non-functional. As with the univents, in order to function properly, exhaust vents must be activated and remain free of obstructions.

Exhaust ventilation in the 1960s portion of the building is provided by ceiling-mounted vents powered by rooftop motors (Pictures 8 and 9). These exhausts were all operating during the assessment. However, the location of some exhaust vents can limit exhaust efficiency. In several rooms, exhaust vents are located near hallway doors (Picture 8). With hallway doors open, exhaust vents in these rooms will tend to draw air from both the hallway and the classroom reducing the effectiveness of the exhaust vent to remove common environmental pollutants.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a univent and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). It was reported by Mr. Wood that the LPS has

a contract with Pioneer Valley Environmental, Inc., an HVAC engineering firm that conducts preventive maintenance of HVAC equipment in all of Leominster's public schools. The preventative maintenance program consists of an annual assessment of all HVAC system components (e.g., univents, AHUs, pneumatic controls, thermostats). A detailed report is generated and provided to the LPS facilities department to address needs.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 ppm. Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such

as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information on carbon dioxide see [Appendix A](#).

All but one room had temperature readings indoors the day of the assessment from 70 ° F to 78 ° F, which were within the MDPH comfort guidelines. One room had a reading of 79 ° F, or just above the recommended range. The MDPH recommends that indoor air temperatures be maintained in a range of 70 ° F to 78 ° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Although temperatures in the building were within or very close to the MDPH recommended comfort range the day of the assessment, occupants on the second floor expressed chronic heat complaints from solar glare. As heat is radiated off the roof it is drawn into classrooms by air intakes for univents, which are located at roof level in these classrooms. Mr. Wood reported that a proposal was being generated to provide these classrooms with air conditioning. In the interim, windows were coated with solar film to help reduce heat.

The relative humidity measurements ranged from 40 to 57 percent, which were within the MDPH recommended comfort range the day of the assessment. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

## **Microbial/Moisture Concerns**

A few areas had water-stained ceiling tiles, which can indicate leaks from the roof or plumbing system. Water-damaged ceiling tiles can provide a source for mold and should be replaced after a water leak is discovered and repaired. Open seams between the sink countertop and backsplash were observed in several rooms (Picture 10). If not watertight, water can penetrate through the seam, causing water damage. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell and show signs of water damage.

Plants were noted in several classrooms, and flowering plants were seen in close proximity to univent air intakes (Picture 3). Plants can be a source of pollen and mold, which can be respiratory irritants for some individuals. Plants should be properly maintained and equipped with drip pans. Plants should also be located away from ventilation sources (e.g., air intakes, univent diffusers) to prevent the entrainment and/or aerosolization of dirt, pollen or mold.

Several classrooms contained aquariums and terrariums. Aquariums should be properly maintained to prevent microbial/algae growth, which can emit unpleasant odors. Similarly, terrariums should be properly maintained to ensure soil does not become a source for mold growth.

Caulking around window panes along the west side of the building was observed to be missing/failing in several areas (Pictures 11 and 12), which can lead to water penetration and potential water damage and/or mold growth. As discussed, window replacement for this portion of the building is on a capital repair list.

## **Other IAQ Evaluations**

Indoor air quality can be adversely impacted by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion products include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers ( $\mu\text{m}$ ) or less (PM<sub>2.5</sub>) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, MDPH staff obtained measurements for carbon monoxide and PM<sub>2.5</sub>.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide pollution and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient-Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from 6 criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS (ASHRAE, 1989). The NAAQS were adopted by



reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS established by the US EPA, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

*Carbon monoxide should not be present in a typical, indoor environment.* If it is present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Outdoor carbon monoxide concentrations were non-detect or ND (Table 1). Carbon monoxide levels measured in the school were also ND (Table 1).

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits for particulate matter with a diameter of 10  $\mu\text{m}$  or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) in a 24-hour average (US EPA, 2000a). This standard was adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent, PM2.5 standard requires outdoor air particulate levels be maintained below 65  $\mu\text{g}/\text{m}^3$  over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, the MDPH uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 51  $\mu\text{g}/\text{m}^3$  (Table 1). PM2.5 levels measured indoors ranged from 20 to 73  $\mu\text{g}/\text{m}^3$  (Table 1). PM2.5 measurements were below or

close to background in all areas, with the exception of classroom C-2, which was above the NAAQS of  $65 \mu\text{g}/\text{m}^3$ .

Frequently, indoor air levels of particulates (including PM<sub>2.5</sub>) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors. In the case of classroom C-2, occupants were cutting construction paper and working on art projects at the time of the assessment.

Indoor air quality can also be impacted by the presence of materials containing volatile organic compounds (VOCs). VOCs are substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. Outdoor air samples were taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC measurements throughout the building were also ND (Table 1).

Please note, that the TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use TVOC containing products (e.g., the concentration of TVOCs within a classroom increases when the product is in use). Dry erase markers were seen in several

classrooms. Materials such as dry erase markers and dry erase board cleaners may contain VOCs (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999). Cleaning products and air deodorizers were found on countertops in some classrooms. Like dry erase materials, cleaning products contain VOCs and other chemicals that can be irritating to the eyes, nose and throat of sensitive individuals.

## **Conclusions/Recommendations**

In view of the findings at the time of the visit, the following recommendations are made to improve general indoor air quality:

1. Consult an HVAC engineer concerning the operability of classroom exhaust vents (Table 1).
2. Use openable windows in conjunction with classroom exhaust vents to facilitate air exchange. Care should be taken to ensure windows are properly closed at night and weekends to avoid the freezing of pipes and potential flooding.
3. Remove all blockages from univents and exhaust vents to ensure adequate airflow.
4. Close classroom doors to maximize air exchange.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (e.g., throat and sinus irritations).

6. Ensure leaks are repaired and replace water damaged ceiling tiles. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
7. Ensure plants have drip pans. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary. Keep plants away from the air stream of univents.
8. Clear plant growth away from the proximity of univent air intakes.
9. Clean and maintain aquariums and terrariums to prevent mold growth and associated odors.
10. Seal areas around sinks to prevent water-damage to the interior of cabinets and adjacent wallboard.
11. Continue with plans to remove and replace carpeting with a non-porous materiel (e.g., tile).
12. Consider adopting the US EPA (2000b) document, “Tools for Schools”, to maintain a good indoor air quality environment on the building. This document can be downloaded from the Internet at: <http://www.epa.gov/iaq/schools/index.html>.
13. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH’s website: [http://mass.gov/dph/indoor\\_air](http://mass.gov/dph/indoor_air)

## References

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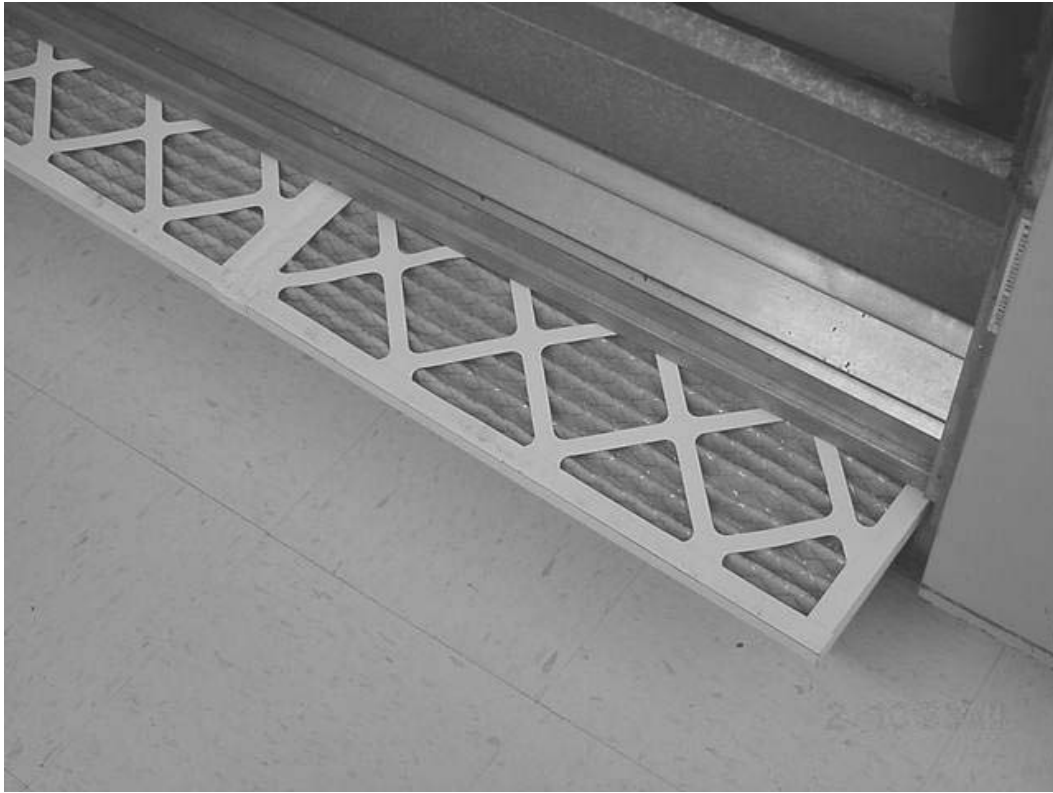
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**Picture 1**



**Classroom Univent**

**Picture 2**



**High-Efficiency Pleated Air Filters in Univent**

**Picture 3**



**Univent Air Intake, Note Flowers in Front of Intake**



**Picture 4**



**Univent Obstructed by Various Items**

**Picture 5**



**Exhaust Vent for 1955 Wing, Note Storage of Materials below Vent**

**Picture 6**



**Undercut Coat Closet Doors for Exhaust Ventilation**

**Picture 7**



**Exhaust Tower**

**Picture 8**



**Ceiling-Mounted Exhaust Vent (1960's Wing), Note Open Hallway Door**

**Picture 9**



**Rooftop Exhaust Motor**

**Picture 10**



**Space between Sink Backsplash and Countertop**

**Picture 11**



**Missing/Damaged Caulking along West Side Windows**



**Picture 12**



**Missing/Damaged Caulking along West Side Windows**

# Northwest Elementary School

45 Stearns Avenue Leominster, MA 01453

# Indoor Air Results

Date: 6/2/2005

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
background		70	46	354	ND	ND	5				
A2	20	70	52	635	ND	ND	41	Y # open: 0 # total: 2	Y univent	Y	Hallway DO, closet, DEM, PF.
A3	22	76	53	530	ND	ND	42	Y # open: 1 # total: 4	Y univent	Y closet	DEM.
A4	7	76	50	484	ND	ND	34	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, DEM.
A5	22	70	54	635	ND	ND	40	Y # open: 0 # total: 2	Y univent	Y closet (off)	
B1	21	75	55	511	ND	ND	36	Y # open: 1 # total: 3	Y univent	Y closet (off)	occupants at lunch.

ppm = parts per million

µg/m3 = micrograms per cubic meter

AD = air deodorizer

AP = air purifier

aqua. = aquarium

AT = ajar ceiling tile

BD = backdraft

CD = chalk dust

CP = ceiling plaster

CT = ceiling tile

DEM = dry erase materials

design = proximity to door

FC = food container

G = gravity

GW = gypsum wallboard

M = mechanical

MT = missing ceiling tile

NC = non-carpeted

ND = non detect

PC = photocopier

PF = personal fan

plug-in = plug-in air freshener

PS = pencil shavings

sci. chem. = science chemicals

TB = tennis balls

terra. = terrarium

UF = upholstered furniture

VL = vent location

WP = wall plaster

## Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred  
600 - 800 ppm = acceptable  
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F  
Relative Humidity: 40 - 60%

Table 1-1

**Northwest Elementary School**  
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**Table 1**

**Indoor Air Results**  
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Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
B2	18	75	55	650	ND	ND	51	Y # open: 0 # total: 3	Y univent	Y closet,	Hallway DO, DEM.
B3	21	75	56	830	ND	ND	39	Y # open: 0 # total: 3			Hallway DO, PF, aqua/terra.
B4	20	74	56	524	ND	ND	39	Y # open: 0 # total: 3	Y univent items furniture	Y	Hallway DO, closet, DEM, PF.
B5	19	74	57	569	ND	ND	42	Y # open: 3 # total: 3	Y univent	Y ceiling	DEM, PF.
B6	23	74	56	656	ND	ND	43	Y # open: 0 # total: 3	Y univent	Y closet	window-mounted AC, DEM.

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									Supply	Exhaust	
B7	0	74	53	578	ND	ND	41	Y # open: 0 # total: 3	Y univent	Y closet,	Hallway DO, window- mounted AC, DEM.
B8	0	75	50	499	ND	ND	38	Y # open: 2 # total: 3	Y univent furniture	Y closet,	PF, occupants at lunch.
B9	2	75	50	565	ND	ND	36	Y # open: 1 # total: 3	Y univent	Y closet, (off)	18 occupants gone 30 min.
C1	20	78	50	772	ND	ND	46	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, DEM, PF.
C12	0	77	46	424	ND	ND	37	N	Y univent	Y ceiling location	Hallway DO, PF, occupants at lunch.
C2	26	77	48	865	ND	ND	73	N	Y ceiling	Y ceiling	paper cutting, active classroom-airborne particulates (+).

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									Supply	Exhaust	
C3	26	78	49	630	ND	ND	43	Y # open: 2 # total: 4	Y univent	Y ceiling	Hallway DO, #WD-CT : 1, DEM, PF.
C4	22	77	48	588	ND	ND	53	Y # open: 2 # total: 4	Y univent	Y ceiling	Hallway DO, breach sink/counter, DEM, PF, aqua/terra.
cafeteria	50	76	50	1053	ND	ND	46	Y # open: 0 # total: 2	Y univent (off)	N	
D0	1	78	44	530	ND	ND	35	N	Y univent	Y ceiling	Hallway DO, DEM, PF, plants.
D1	1	79	40	511	ND	ND	40	Y # open: 1 # total: 2	Y univent	Y ceiling location	Hallway DO, PF.
D10	25	75	43	1344	ND	ND	26	Y # open: 0 # total: 4	Y univent	Y ceiling	window-mounted AC, DEM, aqua/terra, nests.

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D12	0	75	46	660	ND	ND	36	Y # open: 0 # total: 2	Y univent	Y ceiling	Hallway DO, DEM, PF.
D14	24	75	48	790	ND	ND	38	Y # open: 0 # total: 4			
D15	0	76	46	382	ND	ND	38	N	Y univent	Y ceiling	Hallway DO, DEM.
D16	0	76	47	493	ND	ND	40	N	Y ceiling	N	DEM, PF.
D2	6	77	45	592	ND	ND	41	Y # open: 2 # total: 2	Y univent	Y ceiling	Hallway DO, DEM, PF, air freshener, broken CT.

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plug-in = plug-in air freshener

PS = pencil shavings

sci. chem. = science chemicals

TB = tennis balls

terra. = terrarium

UF = upholstered furniture

VL = vent location

WP = wall plaster

**Comfort Guidelines**

Carbon Dioxide: < 600 ppm = preferred  
600 - 800 ppm = acceptable  
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F  
Relative Humidity: 40 - 60%

**Northwest Elementary School**

**45 Stearns Avenue Leominster, MA 01453**

**Indoor Air Results**

**Date: 6/2/2005**

**Table 1**

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
D3	22	79	45	697	ND	ND	38	Y # open: 2 # total: 4	Y univent	Y ceiling	Hallway DO, DEM, PF, plants.
D4	21	77	49	666	ND	ND	40	Y # open: 4 # total: 4	Y univent	Y ceiling	Hallway DO, breach sink/counter, DEM, plants.
D5	1	79	48	629	ND	ND	20	Y # open: 0 # total: 4	Y univent	Y ceiling	DEM, temperature complaints (hot):solar glare- roof, solar film- windows.
D7	1	76	42	594	ND	ND	31	Y # open: 0 # total: 4	Y univent	Y ceiling	window-mounted AC, DEM, plants, Comments : 22 occupants gone 40 min.
D8	4	77	48	550	ND	ND	38	Y # open: 2 # total: 4	Y univent	Y ceiling	Hallway DO, DEM, PF, throw pillows on floor, 20 occupants gone 20 min.
D9	0	76	47	660	ND	ND	25	Y # open: 0 # total: 4	Y univent	Y ceiling	window-mounted AC, DEM, PF.

ppm = parts per million

µg/m3 = micrograms per cubic meter

AD = air deodorizer

AP = air purifier

aqua. = aquarium

AT = ajar ceiling tile

BD = backdraft

CD = chalk dust

CP = ceiling plaster

CT = ceiling tile

DEM = dry erase materials

design = proximity to door

FC = food container

G = gravity

GW = gypsum wallboard

M = mechanical

MT = missing ceiling tile

NC = non-carpeted

ND = non detect

PC = photocopier

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Table 1-6

**Northwest Elementary School**

**45 Stearns Avenue Leominster, MA 01453**

**Indoor Air Results**

**Date: 6/2/2005**

**Table 1**

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
media center	22	77	48	499	ND	ND	39	Y # open: 2 # total: 18	Y univent	Y ceiling	
nurse	1	76	50	661	ND	ND	30	N	Y ceiling	Y ceiling	Hallway DO,
nurse suite	3	76	50	754	ND	ND	32	N	Y ceiling	Y ceiling	
speech/lang	2	76	49	667	ND	ND	33	N	Y	Y ceiling	AP, PF.
teachers room	10	76	54	579	ND	ND	45	Y # open: 1 # total: 3			window-mounted AC, PC.
teachers workroom	0	77	46	635	ND	ND	36	N		N	PC, laminator.

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